

April 11, 1989  
NARRATIVE FOR THE OIL AND GAS  
DEVELOPMENT POTENTIAL OF THE  
BIG COULEE - ELK BASIN MAP MONTANA

Introduction

The Miles City District includes the southern 86 percent of this map (all but the northernmost 18 to 22 miles). The south boundary is the Wyoming State line. The north boundary is the Big Snowy Uplift. The east boundary is a line through Billings and Roundup. The west boundary is a line passing 4 miles west of Big Timber. The area covered in this narrative is 72-78 miles east to west, and 116-120 miles north and south.

Topography is quite variable. The river valleys of the Yellowstone and Musselshell are at about 3,300 feet above sea level. The mountains of the Beartooth Front average about 8,000 feet, with plateaus occurring at 8,000 to 10,000 feet, and the highest peaks near 12,000 feet. Intervening areas include flat prairie, rolling hills, breaks, and small mountains. The principal drainage direction is eastward.

The formations outcropping on this map area represent all ages except Silurian. Quaternary-Tertiary terraces are extensive along the south flank of the Big Snowy uplift and the north flank of the Beartooth Front. There are large areas of Tertiary Ft. Union and Tertiary-Cretaceous Livingston Formations at the surface. Locally, some coarse-grained Tertiary intrusives occur. Cretaceous volcanics cover a large area from near Dean Dome to the west edge of this map. Cretaceous rocks outcrop almost everywhere else except where the Beartooth Front and the Pryor uplift have brought all older rocks to the surface. The Triassic and the Permian pinch out from south to north, by pre-Jurassic erosion, and are present only in the southern  $\frac{1}{4}$  to  $\frac{1}{2}$  of this map area.

Structural features include basins, synclines, anticlines, and fault zones. Basins are represented by the eastern  $\frac{1}{4}$  of the Crazy Mountains Basin, the western edge of the Bull Mountains Basin, and the northwest end of the Big Horn Basin. Major synclines are the Reedpoint at the south, and the Wheatland at the north end of the area. Anticlinal features, from north to south, include Devil's Basin, Devil's Pocket-Pole Creek, Mason Lake, Woman's Pocket, Shawmut, Big Coulee-Hailstone-Rapelje-Lake Basin, Pryor Uplift, Dry Creek-Golden Dome, and the north ends of Elk Basin and Frannie. Major faults or fault zones, from north to south, are Lake Basin fault zone, Fromberg fault, Nye-Bowler lineament, and the thrust faulted Beartooth Front.

In the past 15 years, 705 tests for oil and gas have been drilled. This equates to 4 wells per month (705 divided by 180 months). On April 3, 1989, Petroleum Information was reporting 13 wells in this area. Eight were in southern Yellowstone County, in and around Mosser Dome, and the Fromberg fault at depths of 600 to 1,100 feet. Target formations were the Lower Cretaceous Dakota (Greybull member) and Lakota (Pryor member).

Three are testing for production, and five are apparently dry. Three wells were reported in Carbon County. One is a Greybull test along the Fromberg fault, and is apparently dry. One is a "tight hole" test of the Virgelle member of the Eagle Formation on Golden Dome, and one is an apparent producer in the northwest Elk Basin Field, probably from the Mississippian Madison formation. Two wells are reported in eastern Sweetgrass County. One is a reentry of an abandoned Jurassic Morrison test. An attempted completion in the Upper Cretaceous Virgelle member failed. The other is an announced location for a 4,500-foot Cretaceous Frontier test. These two tests are in the Reedpoint syncline in an area where gas shows have been noted in several Cretaceous horizons.

Drilling activity for the next 15 years is expected at a rate of 0-3 wells per township per year in the following areas: 8 townships lying north and west of Roundup; 23 townships from the Fromberg fault, northwestward, through Lake Basin and Big Coulee to Mud Creek; 1 township in the Broadview area; 1 township in the Crooked Creek area; 3 townships in the Reedpoint area; 3 townships along the Nye-Bowler lineament and Beartooth Front area; and 8 townships north-northwestward from Elk Basin through the Dry Creek-Golden Dome area.

Eight townships, in the southwest part of this map, are so situated behind the Beartooth Front that no wells are expected to be drilled during the next 15 years.

Still behind the Beartooth Front, but nearer to the fault zone, are 6 townships that may have 0-2 wells drilled in the entire 6-township area in 15 years. The townships on the south flank of the Big Snowy Uplift may have 0-2 wells drilled in its entire area in 15 years.

All of the remaining 170 townships will probably vary from 0-3 wells during the upcoming 15 years.

Lands of Crow Indian Reservation on the Pryor Uplift, at the southwest part of this map (comprising about 8 townships), are not treated in the narrative.

### Occurrence Potential

The thickness of the sedimentary package, in the area covered by this map, varies from 0 to perhaps as much as 25,000 feet. A "very low" potential is assigned to the area southwest of the Beartooth Front (about 8 townships), as noted above. This is the only surface exposure of Precambrian rocks to be found on this map. The distance from the Front, where the foot wall and hanging wall of the thrust are both in crystalline Precambrian, is not known with any degree of certainty. However, there is either an overturned interval below the thrust or a sheared off zone of sub-thrust sediments. Either are considered of "low" occurrence potential and are estimated to cover about 6 townships. Areas with less than 2,000 feet of sediments are found on the Pryor Uplift and are considered of "low" potential because this thin sedimentary section is also breached into the Cambrian by the Bighorn River, about 15 miles to the east of this map. Reservoir

rocks of pre-Cretaceous ages may be charged with fresh water from their outcrops along the river.

There is a small area of "moderate" occurrence potential, southeast of the Fromberg Fault, that is on the northwest edge of the Pryor Uplift, where 2,000 feet or less of sediments remain above Precambrian.

All of the remainder of this mapped area is considered to be of "high" occurrence potential.

The Crow Indian Reservation is not classified in this narrative.

Type Log: Superior 71-22 Copulos, 22-2N-21E, Lake Basin Field, Stillwater County.

### Discussion of Development Potential

The largest area of "high" development potential consists of 23 townships, near the center of the map, that are oriented in a NW-SE direction. This area includes 8 producing oil and/or gas fields: Mosser, Laurel, Lake Basin, North Lake Basin, Rapelje, Little Basin, Big Coulee, and Mud Creek.

Mosser Dome, 26-3S-24E, Yellowstone County, produces 22.5 gravity oil from the "Mosser" sand, which may be correlated to the Lower Cretaceous Greybull member of the Dakota Formation, at depths averaging 1,000 feet. Cumulative production is about 350,000 barrels. Thirty wells were drilled in this township in the past 15 years. Due to low drilling investment, this rate will probably continue for the next 15 years. The original discovery well produced gas from the Muddy member of the Newcastle Formation about 300 feet above the "Mosser." Mosser Dome currently has 23 wells on production that are producing a total of 29 barrels per day. Gas and/or oil shows have been noted in wells paralleling the Fromberg fault. Township 3 S., 25 E., should also experience drilling of one well per year.

The Laurel Field in secs. 22, 23, 26, and 27, T. 2 S., R. 24 E., Yellowstone County, produces oil from the Lower Cretaceous Dakota and its basal member, the Greybull sand. Drilling depth is similar to Mosser Dome, and activity is predicted at two wells per year in T. 2 S., R. 24 E. The adjacent townships of 2 S., 23 E., and 1 S., 23 and 24 E., should experience one well per year in the total area ( $\frac{1}{3}$  well per township per year). Laurel Field is presently shut-in.

Lake Basin Field, T. 1 N., R. 21 E., Stillwater County, was discovered in 1924, and produced oil from the Dakota Formation until 1958. Cumulative oil production is reported as 474,000 barrels. Large but unknown quantities of gas were produced from the Frontier-Mowry Big Elk sand, Telegraph Creek, and Eagle.

Current production is only gas from the Upper Cretaceous Telegraph Creek and Eagle. Two or three wells per year are anticipated to be drilled. Significant gas shows have been noted in T. 1 N., R. 22 E., T. 1 and 2 S., R. 21 and 22 E. One well per year may be expected somewhere in this five-township area. Lake Basin currently has 20 wells on production which totals 646 MCFPD (32 MCFPD each).

North Lake Basin Field, T. 2 N., R. 21 E., Stillwater County, is a structural closure on the north end of the Lake Basin anticline. It is 3 miles south of the Lake Basin fault zone. It produces gas from the Frontier-Mowry Big Elk sand and the Eagle Formation. One well per year can be expected in this township. The field currently has two wells producing 26 MCFPD (13 MCFPD each).

Rapelje Field in T. 2 and 3 N., R. 20 E., Stillwater County, is a structural trap with about 50 feet of closure at Eagle depth. The gas producing horizons are Upper Cretaceous Judith River, Claggett, and Eagle-Virgelle sands. This two-township area can expect 2 wells per year for the next 15 years (1 well per township per year). Eleven wells are currently producing 102 MCFPD (9 MCFPD each).

Little Basin Field in T. 3 N., R. 21 E., Stillwater County, produces gas from the Cretaceous Frontier-Mowry at depths of 1,300-1,400 feet. Two wells are currently producing 105 MCFPD (53 MCFPD each). This township can expect to average about 1 well per year for the next 15 years.

Big Coulee-Hailstone Dome Field is located in T. 4 and 5 N., R. 19 and 20 E., Stillwater and Golden Valley Counties, immediately north of the Lake Basin fault zone. The Lower Cretaceous Lakota (3d Cat Creek or Pryor) is the main producing interval in this gas field. There are currently 7 wells on production at a rate of about 926 MCFPD (132 MCFPD each). The deeper Jurassic Morrison and the shallower Lower Cretaceous Kootenai (2d Cat Creek), and the Cretaceous Frontier all contributed gas at some time during the field history. This structural feature is about 6 miles long by 3 miles wide and has at least 200 feet of closure. High structural position yields the best production, but stratigraphic changes along the flanks have controlled some of the production. Multiple pay zones and stratigraphic barriers enhance further drilling. Two wells per year are expected in this area of 5 townships which includes T. 5 N., R. 18 E.

Mud Creek gas field is located in T. 6 N., R. 17 E., Wheatland County. It is a local structural closure on the Shawmut anticline. Amount of closure appears to be about 50 feet. Productive formation is the Pennsylvanian Amsden dolomite from a depth of 2,300 feet. The field has been shut-in since discovery. The lower Cretaceous basal Mowry, at about 900 feet, is also gas productive but shut-in. A gauge of the Amsden gas showed an initial potential of 1.4 MMCFPD.

A well about 9 miles south in sec. 27, T. 5 N., R. 17 E., reported 250 MCFGPD from upper Cretaceous Judith River and Eagle. Gas shows of this magnitude indicate that at least 1 well will be drilled in this area in the upcoming 15 years.

The second largest area of "high" development potential is a group of eight townships in south-central Carbon County where the west-northwest plunging trend of the Elk Basin anticline contains four oil fields. The Dry Creek-Golden Dome anticline, also trending west-northwest along the Nye-Bowler lineament, features four gas fields with some oil production. The Elk Basin trend includes the Elk Basin Field which originally produced from Cretaceous Frontier and Lower Cretaceous Greybull member of the Dakota, Permian Phosphoria, Pennsylvanian Tensleep, Mississippian Madison, Devonian Jefferson, and Ordovician Big Horn Formations. The Greybull, Jefferson and Big Horn are not now producing. Northwest Elk Basin (11 wells) is now producing from Frontier, Tensleep, and Madison (the Greybull has produced in the past); Clarks Fork South, and North, are now shut-in, except for 1 gas well, after producing oil primarily from the Greybull, with some oil from the Frontier. Belfry Field is also shut-in after producing from the Greybull. The three townships, between the Elk Basin structural trend and the Dry Creek structural trend, has only had five wells drilled (four in the last 15 years). However, two of these reported significant gas shows in the Virgelle and the Mowry, and 1 reported oil shows in the Frontier. Undrilled structural traps are probably present and stratigraphic traps are almost a certainty in T. 8 S., R. 21-23 E. Depths to the Jurassic vary from 5,000 in 23 E. to 12,000 in 21 E. This eight-township area can be expected to experience 7 wells per year for the next 15 years.

There is a five-township "high" development potential area in northwestern Musselshell County where 9 wells per year can be expected somewhere in these five townships. Fields include Mason Lake (on the Pole Creek-Devil's Pocket anticline), and Wagon Box and Winnett Junction. Producing horizons include the Cat Creek sands (Dakota-Lakota) at Mason Lake, Tyler at Wagon Box and Winnett Junction, Amsden at Mason Lake (shut-in), and Heath at Devil's Basin (Otter production is shut-in). Multiple objectives and shallow drilling depths (1,500 to 5,500 feet) are incentives for continued operations here.

Three townships along the Nye-Bowler lineament in Carbon and Stillwater Counties, T. 5 S., R. 17 E. and T. 6 S., R. 17 and 18 E., have been productive from six faulted structures. Only one, Dean Dome, is currently producing. The Greybull member of the Dakota and the Lakota are the productive intervals, although gas and oil shows have been noted in the Frontier, Mowry, and Tensleep. Revised structural interpretations (new fault blocks) will generate activity here during the next 15 years at a rate of two wells per year somewhere within the three-township area.

Another three-township area, T. 1 S., R. 17 and 18 E. and T. 2 S., R. 17 E., encompass a currently nonproductive area. However, there have been significant gas shows in the Judith River, Eagle-Virgelle, Telegraph Creek and Frontier, and a new field may be opened in the future. One well per year within this three-township area is expected.

Crooked Creek, T. 4 N., R. 25 E., is a noncommercial Dakota oil field discovered in 1985 in Yellowstone County. One well every 2 or 3 years may be drilled in, or adjacent to, this township. Tensleep oil shows were noted in section 11 in an 8000 Ordovician test.

Broadview is a shut-in gas field in sec. 35, T. 5 N., R. 22 E., Golden Valley County. The Frontier completion was for 930 MCFGPD. Frontier drilling depths are shallow, less than 3,000 feet, in this area, and further exploratory tests are likely. About four wells during the next 15 years are expected in this township, or adjacent to it.

The "very low" (yellow) area of eight townships in Carbon and Stillwater Counties is not expected to experience any drilling during the next 15 years.

The "low" (green) area around the Beartooth Front in Carbon, Stillwater, and Sweetgrass Counties is not expected to have more than one well drilled in the next 15 years. The same is true for the Pryor Uplift "low" area in Carbon County and the Big Snowy Uplift area in Wheatland and Golden Valley Counties.

All of the remaining lands (170 + townships) are considered "moderate" and will average 1 well per township during the next 15 years. During the past 15 years, there were 191 wells drilled in this "moderate" classification area.

## References

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Montana Oil and Gas Statistical Bulletin.